

**REMARKS**

Favorable reconsideration is respectfully requested.

Claim 9 is pending and is currently amended.

Withdrawn claims 1-8 and 10-19 are cancelled.

The amendment to Claim 9 is supported, for example, at page 10 of the specification.

No new matter is added.

**Claim Rejections – 35 U.S.C. § 102**

Claim 9 is rejected under 35 U.S.C. § 102(b) as being anticipated by JP 6299284 (hereinafter referred to as JP'284).

Claim 9 is also rejected under 35 U.S.C. § 102(b) as being anticipated by US 3,368,882 (hereinafter referred to as US'882).

Applicants respectfully traverse each of these rejections.

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." MPEP §2131, citing *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). The prior art does not disclose or suggest a wear-resistant element with a mixed structure containing an Fe-Cr-N compound layer, an Fe-Cr-N diffused layer, and a matrix as recited in claim 1. Furthermore, the prior art does not disclose or suggest that the surface of the sintered and nitrided material is entirely covered with grains or protrusions of  $0.1\sim0.5\mu\text{m}$ .

The Official Action asserts that JP'284 teaches a nitrided sintered member of alloy steel containing Cr. The JP'284 nitriding treatment is performed with gaseous  $\text{N}_2$  to form a nitrided layer. (This disclosure is asserted in the Office Action to read on present claim 9 with the exception of the wherein clause.)

The Official Action also asserts that US'882 teaches a surface hardened metal article with a composition of a steel or alloy containing a nitride-forming element, for example Cr. The metal article is made by sintering in a substantially non-oxidizing atmosphere, and nitrided by ammonia gas at a temperature range of  $500^\circ\text{C}$  to  $650^\circ\text{C}$ .

However, these assertions are incorrect.

The nitriding treatment of the sintered member conducted in both JP'284 and US'882 causes the surface of the sintered member to contain only an Fe-Cr-N compound layer, and does not create an Fe-Cr-N diffused layer, and a matrix in the surface of the sintered and nitrided material. The presently claimed invention creates a mixed structure by performing a quenching treatment on a sintered material, subsequently conducting a nitriding treatment, and finally conducting a finish machining to partially remove a surface of the sintered material. Accordingly, the nitriding treatment of the sintered member in JP'284 and US'882 does not result in a wear resistant element that discloses or suggests the mixed structure limitation recited in present claim 9.

The limitation of claim 9 that the surface of the sintered and nitrided material is entirely covered with grains or protrusions of  $0.1\sim0.5\text{ }\mu\text{m}$  is also not disclosed or suggested by the prior art. The Official Action argues that the presently claimed microstructural surface features are features that depend on the material and the nitriding process. The Official Action then contends that the prior art uses a similar nitriding treatment, and therefore will inherently produce a surface entirely covered with grains or protrusions of  $0.1\text{ }\mu\text{m}$  to  $0.5\text{ }\mu\text{m}$  as presently claimed. However, this assertion is also incorrect.

As described in the present specification with reference to Examples X, Y, and Z, a surface entirely covered with grains or protrusions of  $0.1\text{ }\mu\text{m}$  to  $0.5\text{ }\mu\text{m}$  allows easy nitriding and hardening. In addition, as shown in Figure 5, sample X was subjected to a tempering treatment at a temperature of  $480^\circ\text{C}$  for one and a half hours using an atmospheric treatment, (see page 5, fifth full paragraph of the specification). Meanwhile, samples Y and Z were subjected to a sintering treatment in a non-oxygen atmosphere, and sample Z was subjected to an atmospheric treatment at a temperature of  $480^\circ\text{C}$  for three hours. See the last paragraph on page 11 of the specification. All of the samples X, Y, and Z were finally subjected to a nitriding treatment at a temperature of  $400^\circ\text{C}$  for six hours. As shown in Table 2, sample X had an average hardness of  $64.3\text{HRA}$  ( $\approx 290\text{Hv}$ ), and samples Y and Z had an average hardness of  $65.0\text{ HRA}$  ( $\approx 295\text{Hv}$ ). Table 3 shows the hardness of each sample after the six-hour nitriding treatment at  $400^\circ\text{C}$ . According to Table 3, the hardness of samples X, Y and Z at a distance of  $0.01\text{ mm}$  from the surface is  $1163\text{Hv}$ ,  $837\text{Hv}$ , and  $1240\text{Hv}$ , respectively. This demonstrates that the nitriding increased the hardness at least  $290\text{Hv}$ , to more than  $800\text{Hv}$ .

The results of surface observations reveal that the hardness of the surface layer is closely related to the density of deposits on the surface. See the last full paragraph on page 16 of the specification. In addition, and as can be seen from the hardness and the relatively planar surface condition of sample Y, it is not the case that nitriding always results in a surface entirely covered with grains or protrusions of 0.1  $\mu\text{m}$  to 0.5  $\mu\text{m}$ . In fact, the nitriding of a sintered material as disclosed in JP'284 or US'882 will not create a surface that is entirely covered with grains or protrusions of 0.1~0.5  $\mu\text{m}$  as presently claimed.

In JP'284 the material was held under N<sub>2</sub> gas at a temperature of 1200°C for twenty minutes, and subsequently subjected to a quenching treatment. This is a process which is followed by phase transformation, i.e., a large dimensional change, of the metal. On the other hand, the present invention conducts quenching and subsequent nitriding as shown in Figure 5, wherein the nitriding temperature is low, around 400-430°C. Accordingly, nitriding cannot be effected using nitrogen gas and is conducted using ammonia gas. Also, nitriding at such low temperatures does not cause phase transformation and, hence, the dimensional change is small. This makes it possible to reduce the machining allowance, and provide relatively inexpensive wear-resistant elements with a stable hardness.

Accordingly, the feature of claim 9, which recites that the surface of the sintered and nitrided material is entirely covered with grains or protrusions of 0.1~0.5 $\mu\text{m}$ , is not inherently produced by the prior art processes. This feature is therefore also not disclosed or suggested by the prior art.

No further issues remaining, allowance of this application is respectfully requested.

If the Examiner has any comments or proposals for expediting prosecution, please contact the undersigned at the telephone number below.

Respectfully submitted,

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